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(21) International Application Number: PCT/US98/19745 (22) International Filing Date: 18 September 1998 (18.09.98) (30) Priority Data: 08/933,822 18 September 1997 (18.09.97) US (71) Applicant: ALLIEDSIGNAL INC. [US/US]; 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US). (72) Inventor: BOWERS, Charles, Edward; 3000 West Broadway Street, Hopewell, VA 23860 (US). (74) Agents: CRISS, Roger, H. et al.; AlliedSignal Inc., Law Dept. (R. Fels), 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US).		(81) Designated States: AU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: YARN WITH HEAT-ACTIVATED BINDER MATERIAL AND PROCESS OF MAKING (57) Abstract Yarn suitable for tufting comprises a base fiber ring spun or wrap spun with a second fiber at least partially comprising a heat-activated adhesive material such that the yarn includes from 0.1 to 12, preferably 0.25 to 10, weight percent adhesive material having a melting point within the range of 105° to 190 °C, more preferably 165° to 190 °C. A preferred base fiber is a synthetic staple fiber bundle. A preferred wrapping or insert fiber is a copolyamide fiber, including ternary copolyamides of the 6/66/12 type. When the yarn is twist set by conventional processes and then tufted into carpet, the resulting carpet displays enhanced wear and appearance properties.		

YARN WITH HEAT-ACTIVATED BINDER MATERIAL
AND PROCESS OF MAKING

This is a continuation-in-part application of pending Serial No. 08/792,819
5 filed January 30, 1997 which is a continuation of Serial No. 08/516,506 filed
August 17, 1995 (abandoned) which is a continuation of Serial No. 08/067,413
filed May 25, 1993 (abandoned) which is a continuation of Serial No. 07/436,962
filed November 15, 1989 (abandoned) which is a continuation of Serial No.
06/934,389 filed November 24, 1986 (abandoned).

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1. Field of the Invention

The invention relates to yarn suitable for tufting, especially to form carpet
face fiber, and other applications. The yarn comprises a blend of fibers including a
first, preferably synthetic, base fiber, ring spun or wrap spun with a second fiber
15 that at least partially comprises a heat-activated adhesive material having a melting
point substantially below that of the base fiber. In a process for production of a
yarn suitable for tufting, particularly for use in a carpet, exposure of the yarn to
usual process conditions for twist setting the yarn causes the heat-activated
adhesive material in the inserting or wrapping fiber, as appropriate, to melt
20 substantially completely and flow to points of intersecting base fiber filaments to
create a bond upon subsequent cooling, thus altering properties and performance
of the resulting product.

2. Description of Related Art

25 It has been known to blend non-adhesive fibers with potentially adhesive fibers to
form a yarn or other textile structure or article, then to activate the potentially
adhesive fibers to bond them to contacting fibers, thus modifying end-use
properties of the yarn. U.S. Patent 2,252,999 to Wallach, issued August 19, 1941,
provides a process wherein a yarn comprising an admixture of non-adhesive and
30 potentially adhesive fibers is formed, the potentially adhesive fiber is activated, and
the fibers compacted while in an adhesive condition so that they adhere to each

It is known to wrap fiber, both staple and continuous filament, with a binder strand to physically bind the wrapped fiber to permit downstream processing. See, e.g., U.S. Patents 4,495,758 to Stahlecker et al. and 4,668,553 to Scott et al. Neither of these patents, however, uses or suggests the use of a binder strand or fiber that contains heat-activated adhesive material.

Multiple ends of the twist set yarns are tufted into cut pile carpet and conventionally finished to obtain the desired carpet product.

SUMMARY OF THE INVENTION

Yarn, preferably synthetic, comprises at least one bundle of fiber, the fiber being ring spun or wrap spun with a second fiber (either an insert fiber in the case of ring spun or a wrapping fiber in the case of wrap spun) comprising a heat-activated binder material, preferably a fiber, having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions, such that the yarn comprises a total of 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent binder material. The preferred fiber bundle comprise staple fibers, preferably in the form of a sliver. Alternatively the bundle of fibers may be continuous filaments. The preferred second, binder fiber is a copolyamide, more preferably a copolyamide of the nylon 6/nylon 6,6 type. The preferred bundle of fiber is nylon 6. The present invention is also an article, preferably tufted, more preferably a carpet, made from this yarn. The present invention is also a process of producing a yarn suitable for tufting, the process comprising the steps of:

- a. forming a bundle of fiber, preferably by spinning staple fiber;
- b. ring spinning or wrap spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions to form a yarn comprising 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent of the binder material;
- c. heating the yarn sufficiently to melt the binder material; followed by
- d. cooling the yarn, preferably during twist setting, to solidify the binder material.

A preferred class of binder fiber for use with polyamide base fibers are copolyamides within the specified melting point ranges. Suitable copolyamides of the 6/66/12 type and a process for their production are disclosed in U.K. Patent 1,168,404, issued October 22, 1969 to Inventa A. G., incorporated herein by
5 reference. A melt bonding copolyamide adhesive fiber is commercially available from EMS as GRILON® type K 140 (melting range 130-140°C) and type K 115 (melting range 110-117°C) copolyamides of the 6/66 Type as in U.S. Patent 5,478,624 to Lofquist.

The binder fiber can be blended, wrapped around, or
10 inserted into base fibers, and the resulting fiber blend can then be processed in known ways. It is important to ensure a thorough blending when the binder fiber is blended with base staple fiber to avoid potential clumps in the finished carpet. The fiber blend should contain 0.1-12 weight percent binder fiber, preferably 0.25 to 10 weight percent, and more preferably 5 to 8
15 weight percent. Higher amounts cause undesirable harshness of hand due to the conditions of the twist setting process causing the binder fiber to melt substantially completely. Ring spun or wrap spun yarns prepared from such a fiber blend and subjected to thermal activation can provide strength properties approaching that of bulked continuous filament (BCF) yarns. Properties of BCF yarns can also be
20 enhanced.

By selection of the thermally activated binder fiber within the weight percent ranges and melting point ranges specified it is possible to modify end-use properties of the finished carpet to improve wear resistance, resilience, reduced change of appearance over time and with use, and to increase
25 hand, lustre and apparent value. Denier per filament, cut length, fiber cross-section, crimp type and frequency, surface finish, melt viscosity, softening point, melting point, dye affinity, and other properties are crucial to achieving ideal properties in the final product. A proper selection of the binder fiber must be made to obtain the desired, or optimum results from the finished carpet product.
30 This will depend on numerous factors including the denier, length, crimp, finish, and other properties of the base fiber product.

heated chamber at about 195°C while in a relaxed condition, with a residence time of about 60 seconds.

Multiple ends of this yarn was tufted into cut pile carpet and conventionally finished to obtain the improved product.

5 The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent base staple fiber. The carpet containing the binder staple fiber blend displayed enhanced carpet tuft appearance, more resilience, and better wear resistance.

10 EXAMPLE 2

Carpets also may be produced from bulked continuous filament (BCF) yarns, and carpets thus made can be improved in surface, aesthetics, hand, or in durability and wear by using this invention. In the following example the carpet manufacturer simply uses normal processing techniques to obtain the desired effect.

Filament nylon yarn is produced according to various conventional fiber producer manufacturing methods. These methods are not particularly related to the invention, except that another, smaller, filament yarn will accompany a base yarn throughout subsequent process steps. Often the combination will result in a 2-ply, 3-ply, or other form needed for the carpet style.

In various processes, twisting, entangling, or direct cabling may be utilized. Direct cabling is often used, as in this example, where a 70 denier 14 filament yarn is combined with a 1185 denier 70 filament in the creel of the direct cabler to produce a yarn with 3.5 "S" twist per inch in each of the singles and 3.5 "Z" twist in the resultant 2-ply twisted yarn (1185 x 2 ply). The final yarn contains a third component, a binder yarn, which has a lower melting point and which will lose much of its identity in subsequent process steps, as it is melted and flows to bind fibers and yarn together, thereby retaining the twist in cut pile carpet.

In this example, the 70 denier 14 filament yarn is a copolyamide having a

a binder yarn as described above.

In this example, the continuous bundle (sliver) of base staple fibers is 100% 17 denier per filament AlliedSignal T317 nylon-6 staple fibers that is wrapped with a 30 denier 12 filament yarn at wrap spinning to produce a 3.35/1 cotton count
5 yarn containing 5.2 "Z" wraps per inch. This singles yarn is then plied with another singles end of the same yarn to produce 3.35/2 cotton count 5.2 Z wraps per inch x 5.4 S twists per inch final yarn. This final yarn contains a binder yarn, which is the 30 denier 12 filament yarn wrapped around each end of the 2 plies. This 30 denier yarn is a copolyamide nylon having a melt point range of 105-
10 180°C. The remainder of the 3.35/2 cotton count yarn is AlliedSignal T317 nylon-6 staple fibers having a melt point range of 215-225°C, which results in a blend of about 2.0 percent binder. This ratio can be increased by using a larger denier binder yarn, or by a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being
15 in the continuous bundle (sliver) of base staple fibers, before wrap spinning, that is wrapped with the 30 denier 12 filament binder yarn.

This final 3.35/2 cotton count yarn was twist set by a conventional stuffer box Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds.
20 Multiple ends of this yarn were tufted into cut-pile carpet and conventionally finished to obtain the improved product. The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 2.0 percent wrapper yarn binder displayed tighter and more defined individual pile tufts, a more
25 resilient, stiffer hand, enhanced carpet surface appearance with significantly less hairiness, and better wear resistance.

EXAMPLE 4

30 Carpets also may be produced by introducing a binder yarn at ring spinning before the front delivery roll into a continuous bundle of base staple fibers being

yarn inserted in each end of the 2 plies. This 20 denier yarn is a copolyamide nylon having a melt point range of 105-180°C. The remainder of the 3.0/2 cotton count yarn is AlliedSignal T317 nylon-6 staple fibers having a melt point range of 215-225°C, which results in a blend of about 1.7 percent binder. This ratio can be
5 increased by inserting a larger denier binder yarn at the front delivery roll, or by a low weight percent of heat activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being in the continuous bundle (sliver) of base staple fibers, before ring spinning, in which the 30 denier 12 filament binder yarn is inserted at the front delivery roll of ring spinning.

10 This final 3.0/2 cotton count yarn was twist set by a conventional Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and conventionally finished to obtain the improved product.

15 The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 1.7 percent inserted binder yarn displayed more defined individual pile tufts, a more resilient, stiffer hand, and a cleaner, enhanced carpet surface appearance which is more like a BCF cut pile carpet.

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16. A process for producing a yarn suitable for tufting, said process comprising the steps of:

- a. forming a bundle of fiber;
- b. ring spinning or wrap spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105° to 190°C under ambient humidity conditions to form a yarn comprising 0.1 to 12 weight percent of the binder material;
- c. heating the yarn sufficiently to melt the binder material; followed by
- d. cooling the yarn to solidify the binder material.

17. The process of claim 16 wherein said heating step is accomplished during twist setting of the yarn.

18. The process of claim 16 wherein the bundle of fiber is formed by spinning staple fiber.

19. A wrap spun yarn made in accordance with the process of claim 16.

20. A ring spun yarn made in accordance with the process of claim 16.

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 466 618 A (SA SCHAPPE) 15 January 1992 see the whole document ---	1
A	PATENT ABSTRACTS OF JAPAN vol. 97, no. 9, 30 September 1997 & JP 09 119034 A (UNITIKA LTD), 6 May 1997 see abstract ---	1
A	EP 0 444 637 A (E.I.DU PONT DE NEMOURS AND COMP.) 4 September 1991 see claims 1,4; figure 1; example 1 ---	1,6
A	WO 95 30040 A (KLEEN-TEX INDUSTRIES, INC.) 9 November 1995 -----	